

Upper Mississippi River Nine-Foot Channel Project,
Lock and Dam Number 4
Alma, Wisconsin
Buffalo County, Wisconsin
Wabasha County, Minnesota

HAER No. WI-47

HAER
WIS,
6-ALMA,
1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

Historic American Engineering Record
National Park Service
Department of the Interior
Rocky Mountain Regional Office
P.O. Box 25287
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HISTORIC AMERICAN ENGINEERING RECORD

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Mississippi River Nine-Foot Channel Project, Lock and Dam Number 4

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Location: Alma, Buffalo County, Wisconsin

General Setting and Orientation: Site is located at the city of Alma, Wisconsin, 752.7 miles above Cairo, Illinois, and about 90 miles downstream from St. Paul, Minnesota. The city of Alma is located on the left bank of the river, which was about 800 feet wide at normal stage at the time of construction; high water increased this width by approximately 2,000 feet. To the right of the main channel, the terrain consisted of sand flats and brush willow with intermittent high ground and timber occurring sporadically. The movable dam section of the complex was built from the riverward wall of the lock west 1,367 feet, at which point an earth dam proceeds another 5,485 feet.

Dates of Erection: 1935

Present Owner: United States Government
U. S. Army Corps of Engineers
St. Paul District

Present Use: River navigation/hydrology control

Significance: The Mississippi Lock and Dam Project represents one of the largest and most ambitious of such undertakings. With roots in the Progressive Era, the project was adopted by New Deal proponents to serve the needs of public employment during the Great Depression. Its successful completion turned the upper reaches of the Mississippi River, one of the world's largest rivers, into a intra-continental canal and settled the question of a fully navigable interior river system through the Midwest. Completion of the system helped allay economic inequities in commercial rail and water freight rates brought about as a result of the opening of the Panama Canal. Although significantly altering the environment of the upper Mississippi, the project also served as an impetus for the upgrading of municipal drinking water and sewage disposal systems, as well as providing new recreational opportunities, thus, in the end, proving generally beneficial to public welfare.

Historian: William Patrick O'Brien
October 1987

PART I. HISTORICAL INFORMATION

A. Physical History:

1. Dates of Erection: 1932-1938
2. Architect/Engineer: U. S. Army Corps of Engineers
3. Original and Subsequent Owners: United States Government
4. Builders, Contractors, Suppliers:
 - a. General contractor--lock construction: Quilmotte Construction and Engineering Company, Chicago, Illinois
 - b. General contractor--dam construction: United Construction Company, Winona, Wisconsin
 - c. Subcontractor--dam construction:

LaCrosse Dredging Company, Minneapolis, Minnesota
Fred J. Robers, Burlington, Wisconsin
Hallett Construction Company, Crosby, Minnesota
McClintic-Marshall Corporation, Chicago, Illinois
Commonwealth Electric Company, St. Paul, Minnesota
Beckman Painting Company (location not available)
Pittsburg Plate Glass Company, Minneapolis, Minnesota
W. S. Knott Company, Minneapolis, Minnesota
5. Original Plans and Construction: U. S. Army Corps of Engineers
6. Alterations and Additions:

<u>Item</u>	<u>Year</u>
Bruch fascines and binding poles	1951
Treated timber	1955
Steel	1955
Sand for sandblasting	1957
Electrical equipment	1958
Rubber seals	1958
Splice clips for rails	1958
Traveling mooring bitt assembly	1959
Sand for sandblasting operation	1959
Roadway and parking lot rebuilding	1959
Cathodic protection	1959

<u>Item</u>	<u>Year</u>
Sand for sandblasting	1960
Radio telephones	1961
Sand for sandblasting	1961
Sand for sandblasting	1962
Radio communication system	1962
Remove sandbag barriers	1965
Hydraulic components for tow haulage units	1966
Prefab metal buildings	1967
Slough aeration culvert	1967
Diesel generation unit	1967
Gate operating machinery parts	1967
Power unit for cranes	1968
Gate operating machinery parts	1969
Gravel	1972
Observation platform construction	1972
Prestress Miter gates	1972
Hydraulic drive units	1972
Aluminum gratings	1974
New crane	1981
Scour repair--lock	1982
Roads and walkways	1983
Scour repair--dam	1983

B. Historical Context

Lock and Dam Number 4 were the first structures designed and completed under the Nine-Foot Channel Project in the St. Paul District. At the time of the lock and dam complex, its combination of Roller and Tainter gate elements was cited by at least one contemporary source as being "the first of its type to be constructed." The lock and dam were completed in 1935; other work, such as the establishment of parking and esplanade areas, continued until 1938.

Original piling configurations for the dam were redesigned upon the discovery of a need for longer pilings because of load-bearing considerations. In order that the project not be delayed due to the ordering of additional piles, Tainter gate piers and sill foundations were redesigned, thus spreading the piers apart an addition five feet. The resulting configuration increased the number of piles in each pier foundation by 30 and decreased the number in each sill foundation by seven. Additional adjustment to number of piles and spacing was implemented as the need arose. Cold weather caused trouble with split pilings in the construction of Cofferdam Number 1. Approximately 120 piles were pulled or replaced as a result of this phenomenon. Engineers speculated that sap

freezing in the green pilings may have contributed to the problem. A special steel adapter was designed by the contractor for the driving of concrete pilings, consisting of a steel cylinder approximately 12 inches deep and 18 inches in diameter, topped by a 1-3/4-inch steel plate with a 12-inch steel cylinder about 18 inches high, both cylinders being welded to the plate and lined on each side by rubber belting with a wood block atop the cylinder to cushion the blows of the hammer.

Local ice flow considerations resulted in the establishment of six Roller gates 20 by 60 feet instead of the original configuration of four Roller gates, with passages of 20 by 100 feet. The gates were designed and built by the Treadwell Construction Company of Midland, Pennsylvania, and installed by the McClintic-Marshall Corporation of Chicago. The gates are housed in supporting concrete piers; each is equipped with its own gatehouse containing individual operating machinery. All Roller gates are submersible for three feet. The Tainter gates, constructed and installed by McClintic-Marshall Corporation, consist of 22 units, 35 feet wide and 15 feet high, controlled by a gasoline hoist which moves to each unit by virtue of a small system located atop the bridge. Only three such gasoline hoists were built in the Nine-Foot Channel Project, two being located in the St. Paul District. Tainter gates 16, 17, 27, and 28 were submersible for three feet; the rest of the Tainter gates are non-submersible. The lock and dam foundations consist of piles in sand and gravel.

Lock dimensions are a standard 110 by 600 feet with 24-inch concrete floors. The lock is emptied by 14-inch lock wall tunnels, watering being controlled by four valves located at both ends. Filling is accomplished through a number of openings in the lock walls at the floor of the lock space. Lock lift is 7 feet. Upper normal pool elevation is 667 feet. Depth on upper Miter sill is 17 feet; lower Miter sill is 13 feet.

There were 296 minor injuries, 10 major injuries, and 3 deaths reported during the course of dam construction. The complex was opened to navigation in 1935.

PART II. TECHNOLOGICAL INFORMATION--LOCK

A. General Statement:

1. Architectural character: standardized Ohio-Mississippi lock design.
2. Condition of fabric: good.

B. Description of General Layout and Principal Elements:

1. Overall dimensions: 110 by 600 feet.
2. Foundations: wood and steel sheet pilings in sand and gravel.
3. Walls: reinforced monolithic concrete.
4. Bulkheads: concrete bulkhead configurations occur at each end of the riverward lock wall.
5. Upper and lower guide walls: monolithic reinforced concrete walls extending out from the lock chamber at either end to assist in the guiding of barge traffic into the lock.
6. Stage recorder: small concrete housing located at the end of the lock guide wall. Equipment housed for the recording of river stages.

C. Mechanical Equipment:

1. Operating housed: controls for lock gates and Tainter valves housed in small building on lock wall.
2. Tainter valves: cable drive lock valve of steel construction with electric motorized assembly.
3. Gates: two Miter gates balanced on stainless steel pintels operated by gear arm system and electric motor assemblies. Bumper lines on interior of lock also of stainless steel. All other associated metal parts are of steel, stainless steel, or steel/nickel alloy.
4. Lighting: various freestanding single and double head lighting standards, ca. 1935.
5. Plumbing: lock is watered by four cable-drive Tainter valves serving a system of cast-in-place tunnels that enable the water level to be controlled on the interior of the lock.
6. Winch: motorized assembly to assist towing of barges through lockage.

D. Other Elements:

1. Auxiliary lock: fixed Miter gate without machinery and partial walls located to the riverward side of the lock complex. Equipped with wells for machinery placement. Never completed or put into service.

PART III. TECHNOLOGICAL INFORMATION--MOVABLE DAM

A. General Statement:

1. Architectural character: type 1b Roller gate piers have multipane windows, low hip roofs, and engaged buttress detailing.
2. Condition of fabric: good.

B. Description of Exterior:

1. Overall dimensions: 1,367 feet in length.
2. Foundations: wood and steel piling in sand and gravel.
3. Operating house wall and piers/Tainter gate piers: monolithic reinforced concrete.
4. Structural system: monolithic concrete/structural steel.
5. Bulkheads: concrete bulkheads are located at the base of each gate pier.
6. Operating house openings: one doorway and seven 16-pane industrial sash windows for each Roller gate operating house.
 - a. Doorways and doors: 6
 - b. Windows: 49
7. Operating house roof:
 - a. Shape, covering: low hip roof in corrugated metal.
 - b. Towers: six Roller gate piers and operating house towers; one access pier.
8. Access bridges:
 - a. Shape: linear span without arching.
 - b. Materials: structural steel.

C. Description of General Layout and Principal Elements:

1. Access plans: plan of access consists of a simple exposed concrete stairway built into the landward side of the access pier. Each operating house from that point is connected by an access bridge and rail track in a linear series.
2. Stairways: poured concrete/structural steel
3. Flooring: reinforced concrete
4. Wall and ceiling finish: reinforced concrete
5. Hardware: brass

D. Mechanical Equipment:

1. Movable gates--Roller type: five three-foot submersible units, approximately 20 by 60 feet, operating on tooth track and chain-driven hoist machinery with position gauge located on interior of head house.
2. Movable gates--Tainter type: 22 Tainter gates, 15 by 35 feet, with gauges operating on hoist car and portable chain-driven hoist car machinery. Gates 16, 17, 27, 28 are submersible for three feet.
3. Lighting: some fixtures extant from ca. 1935 period. Rewiring may have taken place over the years. Extent is unknown.

E. Other Elements:

1. Earth dike: linear non-submersible 5,496-foot dike with riprap revetment topped with a clay and gravel road. Earth dike is located at the end of the movable dam section and extends to the west to the Wisconsin river bank.
2. Roller gate and Tainter gate bulkheads: temporary blocking units of structural steel girder construction placed in gate openings in period of emergency or repair.
3. Bulkhead car/tracks: cars designed to store and access bulkheads. Located in storage yard.
4. Flatcar assembly: car for the transport of gate bulkheads and repair materials.

5. Movable crane: vertical lift crane (replaced ca. 1980) used for the moving of parts and equipment. Operates on track system attached to girder spans. Original "A" type unit. Drawings of replacement unit available from St. Paul District.
6. Storage yard: area surrounding the last Roller gate pier on the Wisconsin side. Contains replacement parts for gates, bulkheads on track cars, and related repair items. Also contains track spur for hoist car.
7. Boat launch: single-armed launch of metal construction. Installed ca. 1985.
8. Hoist car: car containing portable machinery for the raising and lowering of Tainter gates. Originally equipped with gasoline-powered hoists, the installation was converted to electric systems in the 1950s. Two car types: Lakeside and American.
9. Tainter gate position indicator.

PART IV. TECHNOLOGICAL INFORMATION--ESPLANADE AREA

A. Description of Esplanade--General Layout:

1. Design character: standardized park/service area component. The esplanade area was originally designed to accommodate the central control station and various service-related functions. Major site alterations have occurred since that time and are noted in the following items.
2. Historic landscape design: based on standardized designs.

B. Condition of Site and Structures: altered.

1. Central control station--exterior: standardized construction. Hip roof; concrete stucco finish.
 - a. First floor contains central control panel and room, bathroom, main office, and basement stairway access.
 - b. Basement contains storage and equipment rooms. All interior finishes altered from original construction.
2. Lockkeeper's/assistant lockkeeper's residences: non-standardized, 1-1/2-story, frame cottage construction with shed dormers. Residences are located in the city of Alma on the bluff just above the lock and

dam site. These are believed to be the only residences of this design employed in the Nine-Foot Channel Project.

3. Outbuildings: various sheds and service buildings have been erected from time to time as demands required--none have particular significance or contribute to the site. A new garage structure of brick and steel was erected on the old site of the lockkeeper's residence, ca. 1985. The element is standardized.
4. A structural steel walkway gives access from the road across an active rail line to the esplanade area. The element is standardized.

PART V. SOURCES OF INFORMATION

- A. Original architectural drawings: St. Paul District Office, Construction Drawings--Nine-Foot Channel Project 1927-1984. Passim.
- B. Early views: Construction Photographs: Lock and Dam 4--Photograph Log Books.
- C. Interviews: Personnel, Lock and Dam 4.
- D. Bibliography:
 1. Primary and unpublished sources: National Archives, Record Group 77; Construction Histories--Lock and Dam 4.
- E. Likely Sources Not Yet Investigated: National Archives, Record Group 77, Suitland, Maryland; St. Louis, Missouri.
- F. Supplemental Material: Aerial Photographs, U. S. Army Corps of Engineers, St. Paul District.

LOCKS AND DAMS 3 THROUGH 10--INDIVIDUAL SIGNIFICANCE AND INVENTORIES

The following outlines document specific significant technologies reflected in the construction of the individual lock and dam complexes, calling attention to unique engineering design items. Changes made to various systems since their initial completion are also a part of this section. A number of maintenance changes have occurred at various times since their completion. Changes made before 1970 are not well documented; many were superficial. Complete documentation to system changes is contained in the monthly condition reports filed with the St. Paul District Office by the various installations. Some changes may have been made over the years without benefit of documentation. Therefore, the following tables should not be interpreted as entirely inclusive.

It should be noted that architectural and engineering components vary significantly from site to site. Architectural styles for gate pier design fall into two categories: those completed prior to 1935-1936 (1a, 1b) and those completed after those dates (2a, 2b). Only one 1a structure exists in the entire 9-Foot Channel system and is located at Rock Island, Illinois; as such it is not a part of this study. The 1b structures are characterized by large, multipane windows, hip roofs, and engaged buttress detailing on the gate house piers. The 2a structures are more streamlined in style with slit, three-pane windows, flat roofs, and no buttress detail. The 2b structures are identical to 2a elements except for addition of a metal panel in the Roller gate track section of the gate piers that does not occur in 2a structures. Only 1b and 2a architectural types occur in the St. Paul District. Other elements such as central control stations, lockkeepers' residences, and associated structures are standardized unless otherwise noted.

Dates for the construction of each complex are given from the beginning of initial work to the end of the project and do not necessarily reflect the construction dates of any single element. Complete construction histories for each complex containing exhaustive documentation for the building of the lock, dam, esplanade features, and other attendant installations are on file with the St. Paul District Office. These histories contain comprehensive listings for all general contractors and subcontractors involved in the project as well as a listing for all material suppliers. For the purposes of this study, information regarding contractors and subcontractors has been reproduced as it appears in the construction histories; as a result certain inconsistencies appear as a matter of course. For example, in some histories the contractor's business location is cited by city; in others this information is not included. In addition, approximately 10,000 separate construction drawings and illustrations were produced during the project and during the course of maintenance since its completion. Drawings were selected from among these materials to illustrate both standardized elements as well as those pertaining to specific sites. Drawing numbers are noted at the end of entries where applicable; "()" indicates standardized elements illustrated elsewhere in the system; "*" indicates elements for which drawings are not readily available. General index sheets have also been reproduced at the beginning of each lock and dam illustration collection for a complete reference. Contemporary photographic documentation including 16mm film footage served to document the project. Photographs are on file in the St. Paul District Office and at each individual installation. Sixteen millimeter film footage is available in video cassette format from the St. Paul Office.

Dimensions for the movable gate sections are given in approximate figures based on the general notations as found in official Corps publications. For example, Roller gates are generally cited as being standardized as either 60 by 20 feet or 80 by 20 feet; however, in the construction history notations, gate lengths are often given exactly as 88 feet 10 1/2 inches long and 15 feet in diameter. Similar approximations apply to information concerning Tainter gate elements. Measurements in both instances should be taken only as approximations for use in categorizing the various sizes and styles of installations and not as an exact measure per se.